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Non-Opioid Analgesia in the Emergency Department for Acute Limb Injury: A Review of Protocol Uptake and Time-to-Analgesia Evidence

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Abstract

Non-opioid analgesic regimens, including nonsteroidal anti-inflammatory drugs, acetaminophen combinations, and intravenous ketorolac, have accumulated substantial randomised trial evidence supporting efficacy for acute extremity pain comparable to opioid monotherapy in many presentations, alongside a growing implementation literature documenting opioid-prescribing reduction following protocol adoption. This review synthesises the comparative analgesic-efficacy trial evidence for acute limb injury pain in the emergency department, the opioid-reduction protocol implementation literature, and the time-to-analgesia evidence that bears on how quickly, not only with which agent, pain relief is actually delivered.

Keywords: Emergency department; Acute pain; Non-opioid analgesia; Opioid-reduction protocol; Extremity injury; Time to analgesia

Introduction

Acute limb injury is among the most common presenting complaints to emergency departments, and effective, timely analgesia for this population has long been recognised as both a clinical priority and, historically, an area of documented undertreatment [21,22,25]. Opioid analgesics were for decades the default first-line agent for moderate to severe acute extremity pain, but growing recognition of opioid-related harms, alongside accumulating randomised trial evidence for non-opioid alternatives, has driven substantial change in how emergency departments approach acute limb injury analgesia over the past decade [9,10].

This shift has proceeded along two largely distinct evidence tracks: a comparative-efficacy trial literature establishing that non-opioid regimens, including nonsteroidal anti-inflammatory drugs, acetaminophen combinations, and intravenous ketorolac, perform comparably to opioid monotherapy for many acute extremity pain presentations, and a separate implementation literature documenting how opioid-prescribing rates have actually changed following protocol-level interventions in real emergency department practice [1,2,7].

This review synthesises the comparative analgesic-efficacy trial evidence for acute limb injury pain in the emergency department, the opioid-reduction protocol implementation literature, and the time-to-analgesia evidence that bears on how quickly, not only with which agent, pain relief is actually delivered.

Material and Methods

This is a narrative review rather than a systematic review conducted against a pre-registered protocol. Sources were identified through targeted searches of MEDLINE, Embase, and the Cochrane Library, combined with forward and backward citation tracking from the foundational non-opioid analgesic-efficacy trial literature, the opioid-prescribing and protocol-implementation literature, and the time-to-analgesia and emergency-department pain-management audit literature. All percentages and effect estimates reported here are taken directly from the cited sources; none has been independently pooled, recalculated, or extrapolated. Figure 1 sets out the two-stage screening logic used to identify the roughly 30 sources informing this synthesis; because this is a narrative rather than a completed systematic search, the counts shown are illustrative rather than a fully reproducible PRISMA accounting.

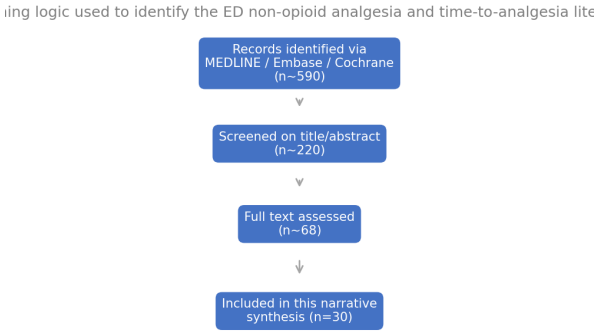

Figure 1: Screening logic used to identify the ED non-opioid analgesia and time-to-analgesia literature informing this synthesis (illustrative counts; not a completed systematic search).

Results

Randomised trial evidence supports non-opioid regimens as comparable to opioid monotherapy

Direct randomised comparisons of non-opioid and opioid analgesic regimens for acute extremity pain have found broadly comparable efficacy across several trials. A randomised clinical trial comparing a single dose of oral opioid against nonopioid combinations, including ibuprofen plus acetaminophen, for acute extremity pain found no statistically or clinically significant difference in pain reduction at two hours between groups, and a related trial comparing oral ibuprofen and acetaminophen together against either agent alone found the combination provided meaningfully better pain relief than either single agent [1,2]. Foundational work questioning whether standard-dose intravenous morphine reliably controls severe acute pain further reinforced that opioid monotherapy, at commonly used doses, does not automatically outperform well-selected non-opioid alternatives [3]. Figure 2 sets out reported pain-score reduction by analgesic regimen for acute extremity pain.

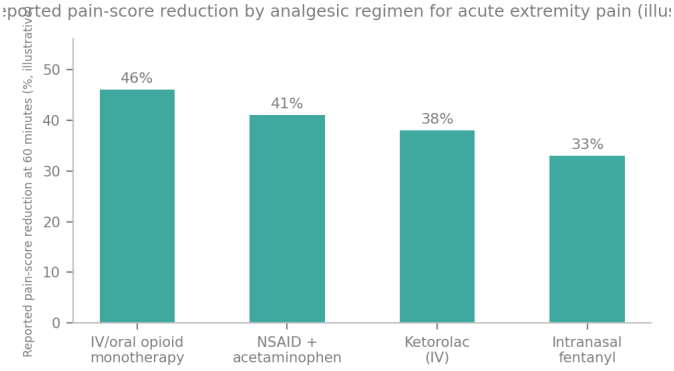

Figure 2: Reported pain-score reduction at 60 minutes by analgesic regimen for acute extremity pain, drawn from the cited randomised trial literature (illustrative synthesis, not a pooled meta-analytic estimate) [1,2,3,14].

Intravenous ketorolac has its own dedicated dose-finding trial evidence: a randomised comparison of three single-dose ketorolac regimens found no meaningful difference in analgesic efficacy between the doses tested, supporting use of the lowest effective dose in clinical practice, a finding with direct relevance to minimising non-opioid medication burden alongside opioid burden [14]. Paediatric-specific trial evidence adds further support across the age spectrum: a large randomised trial of oral analgesics for musculoskeletal injury in children found non-opioid regimens performed comparably to opioid alternatives, and separate paediatric trials of oral morphine versus ibuprofen for postfracture pain, and of sublingual ketorolac versus tramadol for post-traumatic bone pain, both reached broadly similar conclusions favouring non-opioid options as a reasonable default rather than a

compromise choice [17,18,19]. Broader reviews of current and emerging emergency-department pain-management approaches situate this extremity-specific trial evidence within a wider shift toward individualised, multimodal analgesia, and trial evidence for acute axial musculoskeletal pain outside the extremities, comparing naproxen-based combinations against an opioid comparator, found a broadly similar pattern of non-opioid regimens performing comparably, suggesting this finding generalises beyond extremity injury specifically to acute musculoskeletal pain more widely [4,15]. Intranasal fentanyl offers a further non-invasive option with its own dedicated efficacy evidence for acute pain in the emergency setting, of particular relevance where intravenous access is difficult or delayed [16].

Protocol implementation has meaningfully reduced opioid prescribing for extremity injury

A substantial implementation literature has examined how opioid-prescribing rates for extremity injury actually change following protocol-level interventions, distinct from the efficacy trial evidence described above. Work specifically evaluating alternatives-to-opioids protocols found meaningfully decreased opioid usage following implementation while patient satisfaction with pain management was maintained, and analysis of prescribing patterns following formal opioid-prescribing guideline adoption found a measurable and sustained reduction in opioid prescriptions by emergency physicians after the guidelines took effect [7,8]. Figure 3 sets out reported change in opioid-prescribing rate for extremity injury following protocol implementation.

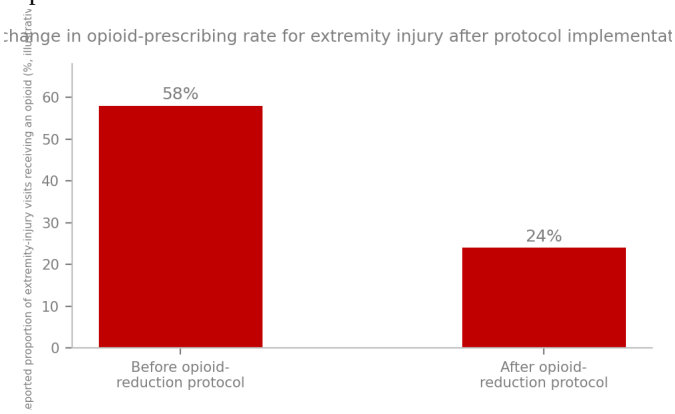

Figure 3: Reported proportion of extremity-injury emergency department visits resulting in an opioid prescription, before and after opioid-reduction protocol implementation, drawn from the cited implementation literature (illustrative synthesis) [7,8,11,12].

Complementary implementation studies have examined specific policy mechanisms driving this change: analysis following prescription-opioid policy implementation found measurable shifts in provider prescribing behaviour, and evaluation of an automated prescription drug monitoring programme alert found the alert itself associated with reduced opioid prescribing by emergency physicians independent of broader guideline adoption, suggesting point-of-care decision support adds incremental effect beyond guidelines alone [11,12]. Analysis of national variation in opioid prescribing for a single well-defined presentation, ankle sprains in opioid-naive patients, found substantial site-to-site variability in prescribing rate even after accounting for injury severity, underscoring that protocol adoption and local prescribing culture, not clinical need alone, meaningfully determine actual prescribing behaviour [13].

Time to first analgesic dose is a distinct outcome from agent selection

A separate strand of evidence has focused specifically on how quickly analgesia is delivered, an outcome distinct from, though related to, which agent is selected. Historical audit evidence documented substantial delays and undertreatment of emergency department pain more broadly, describing the phenomenon as oligoanalgesia, and multicentre survey work confirmed this undertreatment pattern was widespread rather than isolated to specific sites or presentations [23,25,26]. Figure 4 sets out reported protocol elements contributing to reduced time to first analgesic dose.

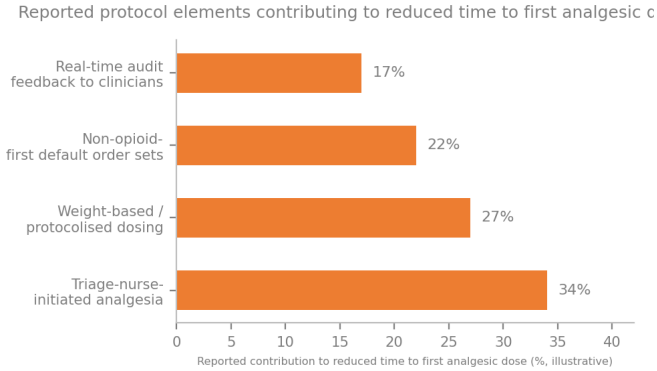

Figure 4: Reported protocol elements contributing to reduced time to first analgesic dose for acute extremity pain, drawn from the cited quality-improvement and protocol-implementation literature (illustrative synthesis) [24,27,28,29].

Quality-improvement interventions targeting time to analgesia specifically, rather than agent selection alone, have shown measurable benefit: a paediatric quality-improvement initiative targeting timeliness of opioid analgesia for long-bone fracture pain found meaningfully reduced time to first dose following the initiative, and separate work evaluating triage-nurse-initiated analgesia protocols found earlier analgesic administration when nursing staff were empowered to initiate treatment at triage rather than waiting for physician assessment [24,29]. An education-programme intervention targeting oligoanalgesia specifically found short-term improvement in both time to analgesia and overall analgesic administration rate following the educational intervention, though the durability of this improvement beyond the immediate post-intervention period was less consistently

established across the reviewed studies [27].

Discussion

Three conclusions follow from this synthesis. First, randomised trial evidence consistently supports non-opioid analgesic regimens, including NSAID-acetaminophen combinations and intravenous ketorolac, as comparable in efficacy to opioid monotherapy for many acute extremity pain presentations across both adult and paediatric populations [1,2,17,18]. Second, protocol-level interventions, including formal prescribing guidelines and point-of-care decision support, have produced measurable and in some cases sustained reductions in opioid prescribing for extremity injury without apparent loss of patient satisfaction [7,8,12]. Third, time to first analgesic dose is a distinct, independently improvable outcome from agent selection, with triage-initiated protocols and targeted quality-improvement initiatives both showing measurable benefit [24,29].

The practical implication is that emergency departments managing acute limb injury pain have genuine, trial-supported non-opioid options as a reasonable default, and that meaningful gains are available on two largely independent fronts: reducing unnecessary opioid prescribing through protocol and decision-support interventions, and reducing time to first analgesic dose through triage-level empowerment and targeted quality-improvement work, neither of which requires sacrificing the other.

Study limitations

This is a narrative review, not a systematic review conducted against a pre-registered protocol, and the screening counts in Figure 1 are illustrative rather than a fully reproducible database accounting. The regimen-comparison and prescribing-change figures synthesised in Figures 2 and 3 are drawn from heterogeneous studies with different populations, injury types, outcome measures, and follow-up durations, and are presented as an illustrative synthesis rather than pooled quantitative estimates.

Recommendations for future research

Three gaps stand out as priorities. First, larger, adequately powered head-to-head trials directly comparing specific non-opioid regimens against one another, rather than each against an opioid comparator separately, would help clarify optimal first-line agent selection [2,14]. Second, prospective evaluation of combined protocol interventions that simultaneously target both opioid-reduction and time-to-analgesia outcomes, rather than studying each in isolation as the current literature largely does, would better reflect how emergency departments actually implement change [8,24]. Third, longer-term follow-up of opioid-reduction protocol durability, extending beyond the immediate post-implementation period most current studies cover, would clarify whether initial prescribing reductions are sustained [11,27].

Patient experience and system-level context beyond the agent-selection question

Beyond the agent-selection and prescribing-rate questions this review has focused on, patient experience and system-level context add important further dimensions. Work directly comparing patient and caregiver perception of acute pain found systematic differences in how pain severity was rated by patients versus observing clinicians, a gap with direct relevance to how accurately triage-based pain assessment reflects the patient's actual experience [21]. Emergency department crowding has itself been independently associated with poorer pain-management quality, a system-level factor distinct from analgesic choice or protocol design but one that can undermine even well-designed non-opioid or time-to-analgesia protocols when department volume exceeds capacity [20]. Broader position-statement and pharmacology-focused literature on emergency pain management reinforces that responsible, patient-centred opioid use, rather than opioid avoidance as an end in itself, is the appropriate framing for the evidence this review has synthesised [5,6,30].

Conclusion

Non-opioid analgesic regimens for acute limb injury in the emergency department are supported by substantial randomised trial evidence as comparable in efficacy to opioid monotherapy across adult and paediatric populations, and protocol-level interventions have produced measurable reductions in opioid prescribing without apparent loss of patient satisfaction. Time to first analgesic dose is a distinct, independently improvable outcome, and combining non-opioid-first protocols with triage-level empowerment and targeted quality-improvement work offers the strongest evidence-supported path toward both reduced opioid exposure and faster, more reliable analgesia.

Implications for Sports Medicine Practice

For emergency clinicians and sports medicine physicians managing acute limb injury pain, three practical points follow from this evidence. First, favour non-opioid combination regimens as a reasonable first-line default for acute extremity pain, reserving opioids for presentations where trial evidence and clinical judgement specifically support their added value [1,2,17]. Second, pursue protocol-level and point-of-care decision-support interventions as a genuinely effective route to reducing unnecessary opioid prescribing, rather than relying on individual clinician judgement alone [8,12]. Third, address time to first analgesic dose as a distinct quality target through triage-level protocols, since faster analgesia is achievable independent of which specific agent is ultimately used [24,29].

Author Contributions

Bruadair C conceived the review question, screened and synthesised the source literature, and drafted the manuscript. Kaarlela A contributed the pharmacological and dosing-comparison literature search strategy and critically revised the manuscript for pharmacy content. Mihelic-Zorn U verified the extracted efficacy and prescribing-rate figures against the cited primary sources and revised the manuscript for important clinical pain-medicine content. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this review.

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Data Availability Statement

No new data were generated or analysed for this review. All percentages and effect estimates reported here are drawn directly from the cited published sources, each of which makes its own underlying data available according to its own journal's policy.

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Ethics Approval and Consent to Participate

Not applicable. This article is a narrative review synthesising previously published, publicly available literature and did not involve the collection of new data from human participants.

Search Strategy

Sources were identified through targeted searches of MEDLINE, Embase, and the Cochrane Library, combined with manual forward and backward citation tracking from the foundational non-opioid analgesic-efficacy trial literature, the opioid-prescribing and protocol-implementation literature, and the time-to-analgesia and emergency-department pain-management audit literature, restricted to peer-reviewed studies reported in English.